BELLCOMM, INC.
1100 Seventeenth Street, N.W. Washington, D.C. 20036

SUBJECT: The Common Space Fleet - A Brief Description Case 730

DATE: March 18, 1968

FROM: C. L. Davis
J. M. Tschirgi

ABSTRACT

A particular set of vehicles is described. This set fulfills the requirements of a common space fleet. Such a fleet will provide the ability to carry out missions in earth orbit, on the lunar surface, and to any location between 0.5 AU and 2.0 AU.

BELLCOMM, INC.
1100 Seventeenth Street, N.W. Washington, D.C. 20036

SUBJECT: The Common Space Fleet - A Brief Description Case 730

DATE: March 18, 1968

FROM: C. L. Davis
J. M. Tschirgi

MEMORANDUM FOR FILE

This memo outlines the simple functional idea of a space exploration program based on common hardware and describes the resulting vehicles we have proposed to illustrate the meaning of the adoption of such a policy.

The three fundamental functions that need to be satisfied to achieve manned flight for extended periods in space are common to all mission areas: Earth Orbit, Lunar, Planetary, and Cislunar Rescue. These functions are:

1. Primary Propulsion - To provide the impulse necessary for all primary maneuvers, earth depart, midcourse, earth return.

2. Earth Entry - To return men and payload from space, including hyperbolic direct entry, to the surface of earth.

3. Space Transportation - To transport men and material through space to a destination.

This list excludes those functions which are peculiar to particular mission objectives, such as Astronomy. The primary postulate of the Common Space Fleet concept is that a few vehicles may be built which, perhaps with small modifications, will provide these functions to all the mission areas for two decades.

The spectrum of missions which have been considered is outlined below.

MISSION SPECTRUM

	Flyby	Orbital	Landing
Required			
Mars	x	x	x
Earth		x	x
Moon		x	x
Venus	x	x	

	Flyby	Orbital	Landing
Desired			
Mercury	x		
Jupiter	x		
Asteroids	x		

The requirements of these missions may be summarized as:

- The system will be capable of operating from 0.5 AU out to about 2.0 AU for periods of two or three years without support from earth. This includes any orbit about Mars, Moon, Earth, and Venus.
- It is desirable that the system be capable of operating to within 0.25 AU of the sun and beyond Jupiter.

Descriptions and uses of vehicles associated with these missions are presented below. Since the vehicles are generally multi-functional, particular vehicles cannot be identified with particular functions.

The Common Mission Module

This vehicle provides those facilities which are common to crew support and required for operation of the spacecraft during the space transportation phase.

Living Quarters
Life Support
Environmental Control and Protection
System Monitoring and Control
Communications
Power
Guidance and Navigation

It is in fact two modules based upon identical primary structure, each a pressure vessel one deck high, suspended within a 260" O.D. cylindrical shroud, as shown on Figure 1. One vehicle may be considered the "home" and the other the "office." As shown it is a four man system capable of two years operation without external support.

Should an eight man space vehicle be required, a third module is added, thus providing two living quarters modules and one command and operations module. A configuration of two separate vessels with independent environmental and life support subsystems was chosen to provide the required measure of redundancy for deep space missions and to allow the flexibility of using a single module for shorter duration and/or smaller crew missions as are typical of lunar exploration.

The Propulsion Module I

A 140,000 lb gross weight vehicle using H_2 and O_2 propellants; the PM-I acts in the following roles:

As a fourth stage on Saturn V equipped with lunar landing gear, it will be able to land over 43,000 lbs of cargo on the moon.

As a propulsion stage to inject manned planetary spacecraft from earth, retro at the planet (Mars or Venus) and escape from the planet for the return trip to earth.

As a fourth stage on Saturn V to launch unmanned probes.

As general maneuvering propulsion in cislunar space for rescue missions.

Figure 2, taken from Reference 1 shows a possible configuration.

The Propulsion Module II

A 25,000 lb gross weight vehicle using FLOX and Methane, PM-II performs the following tasks:

Return propulsion from lunar surface for up to 4 men in an earth return vehicle plus some discretionary payload.

Abort from injection phase of ballistic planetary missions.

Midcourse, attitude control, and station keeping propulsion for planetary and earth orbit missions.

General maneuvering propulsion in cislunar space for rescue missions.

Figure 3 shows a configuration taken from a preliminary design study to be published shortly.

The Earth Depart and Entry Module (EDEM)

This is a vehicle similar in function and configuration to an Apollo CM with some important distinctions:

- Entry Velocity Capability - 55,000 fps
- Crew Size = 4
- Two or more years space storability
- Two weeks active life

With these abilities, it becomes capable of supporting all the outlined missions. It can support 4 men for up to two weeks thus allowing use for trans-earth-lunar flights and abort from the very early period of planetary flights. The storage time permits use for crew return from a planetary mission, from a lunar base mission or a space base in earth orbit. Finally, it is used as the earth depart vehicle for men, thus fulfilling the need for abort capability during launch.

Launch Vehicle

The Saturn V with relatively minor uprating (the so-called product improved version) and its derivative, INT-20, would be used for at least two decades. Nuclear propulsion would not be necessary in this period. Manned and unmanned logistics support for earth orbit missions would also be supplied by the Titan launch vehicles.

With these vehicles, all mission areas of interest can be mechanized as illustrated in Table I. Figures 4 through 7 illustrate the application of these vehicles to three mission areas of principal interest. Note that there are only a few basic launch configurations, thus minimizing complexity, interfaces and resulting costs.

At this time studies are continuing in the areas of lunar base missions, high energy earth orbit missions, economic implications of commonality, subsystems for the CMM, preliminary design of the CMM and PM-II, etc.

The particular vehicle configurations presented here are by no means the only possible set satisfying the requirements, but they do represent a compatible set which have been studied in sufficient depth to establish feasibility of the basic idea.

C. L. Davis

J. M. Tschirgi

1013-$\frac{CLD}{JMT}$-nmm

Attachments
Table 1
Figures 1-7

TABLE 1

SPECTRUM				
MISSION / HARDWARE	LUNAR	PLANETARY	EARTH ORBIT	RESCUE
EARTH ENTRY MODULE	E. E. M.	E. E. M.	E. E. M.	E. E. M. AND MISSION MOD.
COMMON MISSION MODULE	SURFACE SHELTER LONG TIME ORBIT	VENUS FLYBY & ORBIT, MARS FLYBY, ORBIT & LANDING	SPACE STATION BUILDING BLOCK 24 HR ORBIT CAPABILITY	---
PROPULSION MODULE I	LOGISTICS LANDER	INJECTION, RETRO & ESCAPE EARTH, MARS, & VENUS	?	LUNAR LANDER ORBIT MANEUVER
PROPULSION MODULE II	LUNAR ASCENT	ABORT & MIDCOURSE	STATION KEEPING	LUNAR ASCENT ORBIT MANEUVER
LAUNCH VEHICLE	SA 5	SA 5	SA 5, TIII AND DERIVATIVES	SA 5, DERIVATIVES

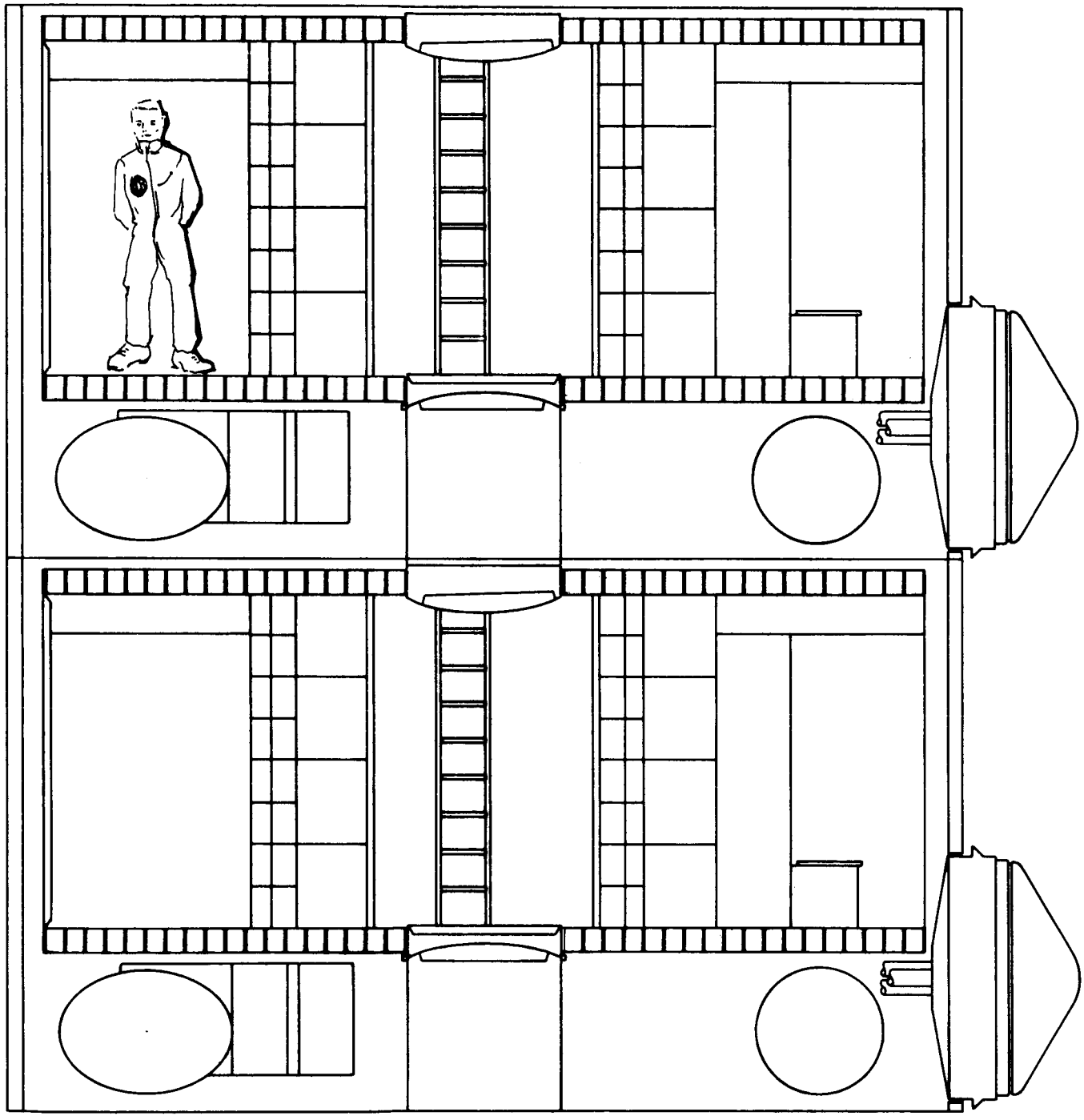


FIGURE 1 - COMMON MISSION MODULE

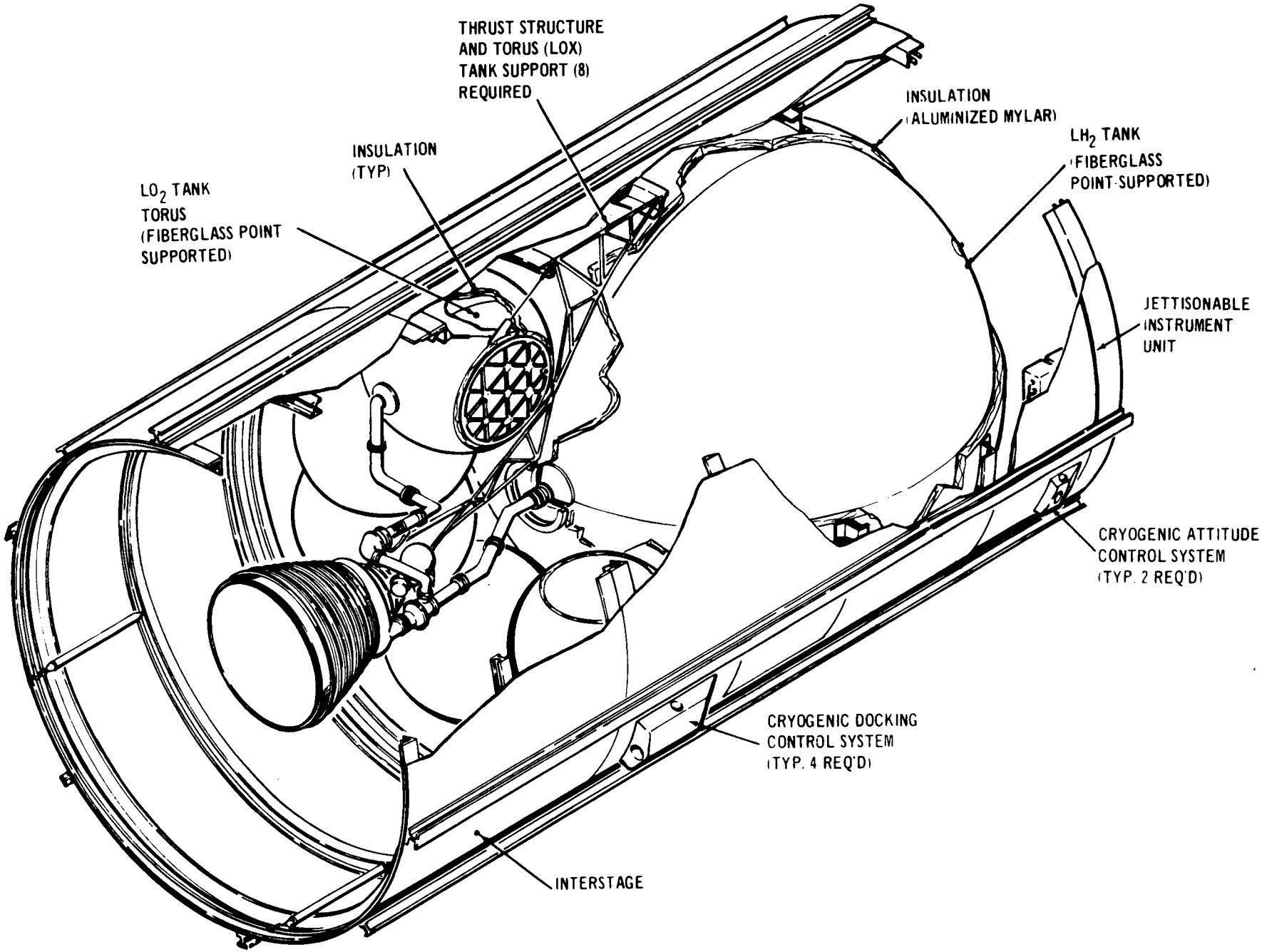


FIGURE 2 - PM I (FIGURE TAKEN FROM DOUGLAS AIRCRAFT CO. REPORT DAC-58052 CONTRACT NAS 8-18032)

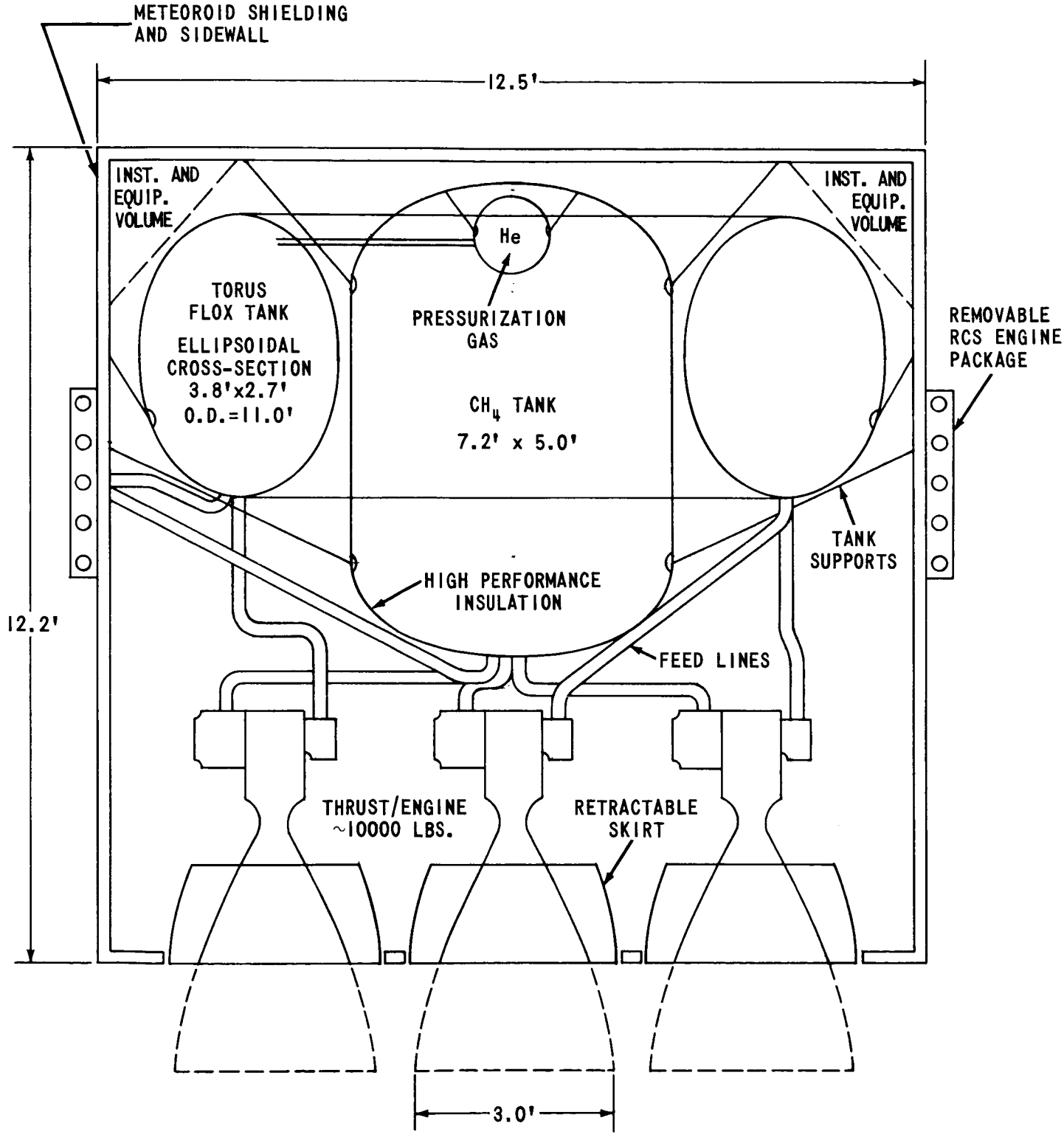
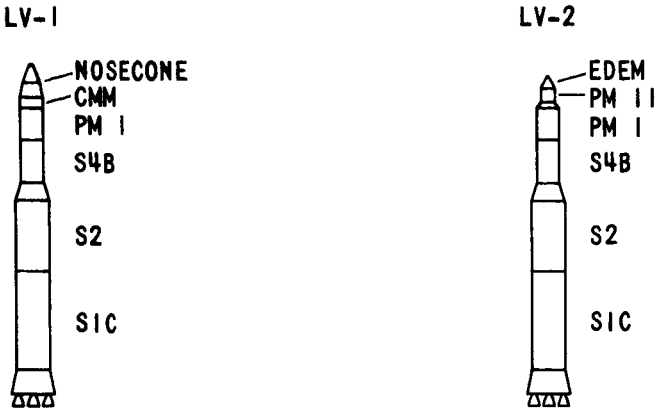
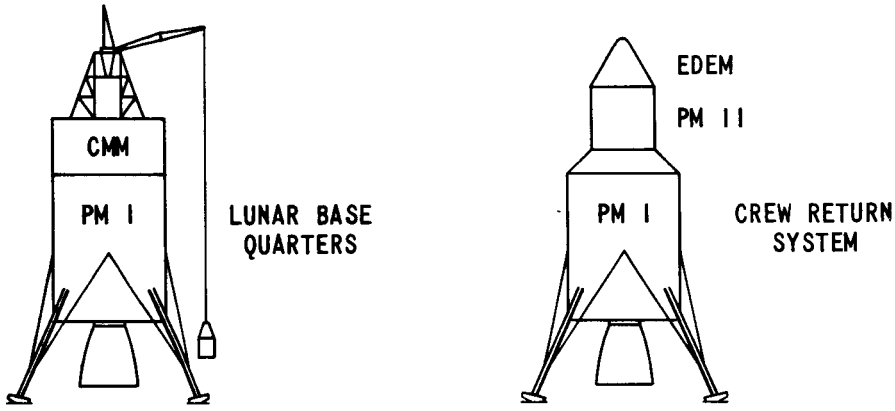


FIGURE 3 - PROPULSION MODULE II ($FLOX/CH_4$)

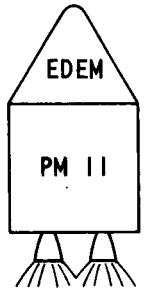
EARTH
LAUNCH
CONFIGURATION



LUNAR LANDED
CONFIGURATION



LUNAR ASCENT
& RETURN TO
EARTH



EARTH ENTRY
& LANDING

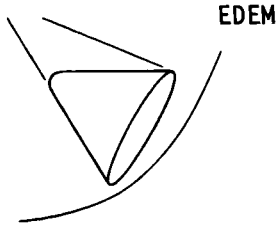
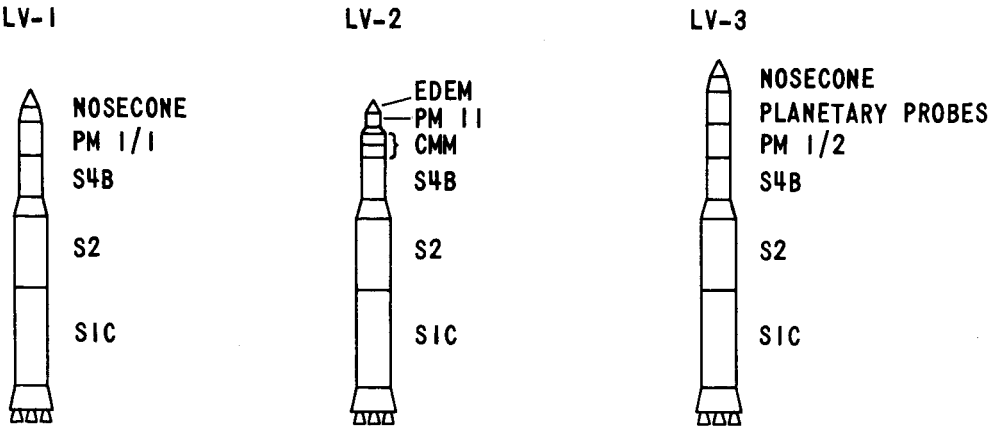
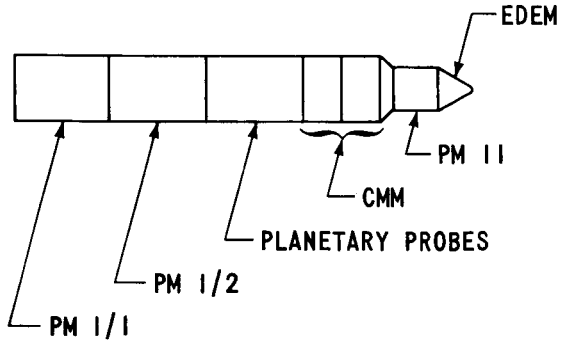


FIGURE 4 - LUNAR MISSION

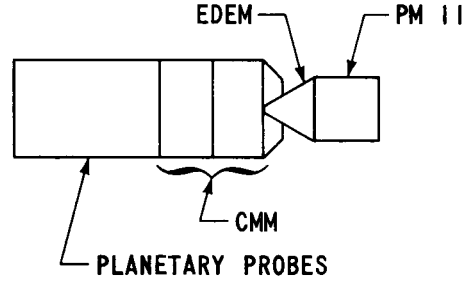
EARTH LAUNCH CONFIGURATION



HIGH ENERGY EARTH RENDEZVOUS AND DOCKING ORBIT



INTERPLANETARY COAST



EARTH RETURN

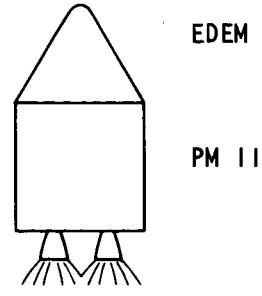
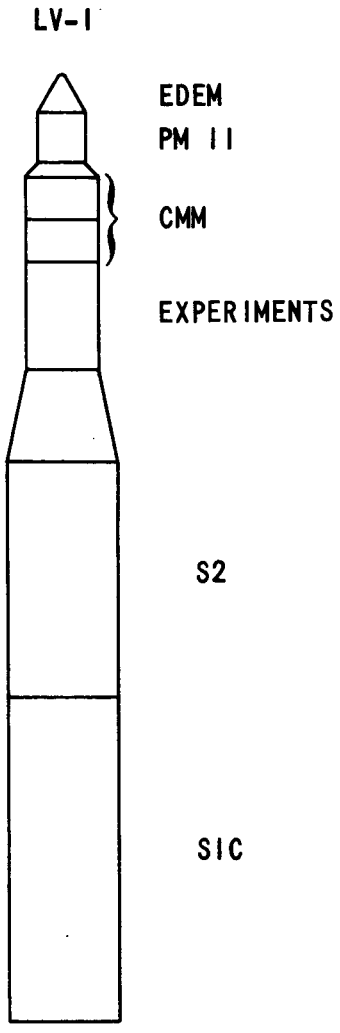


FIGURE 5 - MULTI-PLANETARY FLYBY MISSION

EARTH LAUNCH
CONFIGURATION



IN-FLIGHT
EARTH ORBIT
SPACE BASE

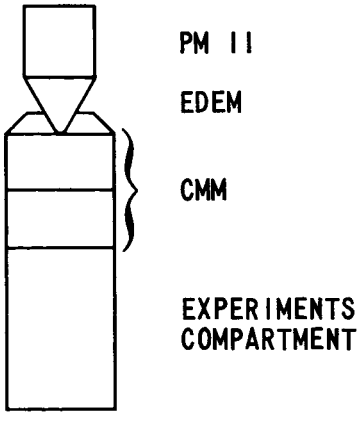
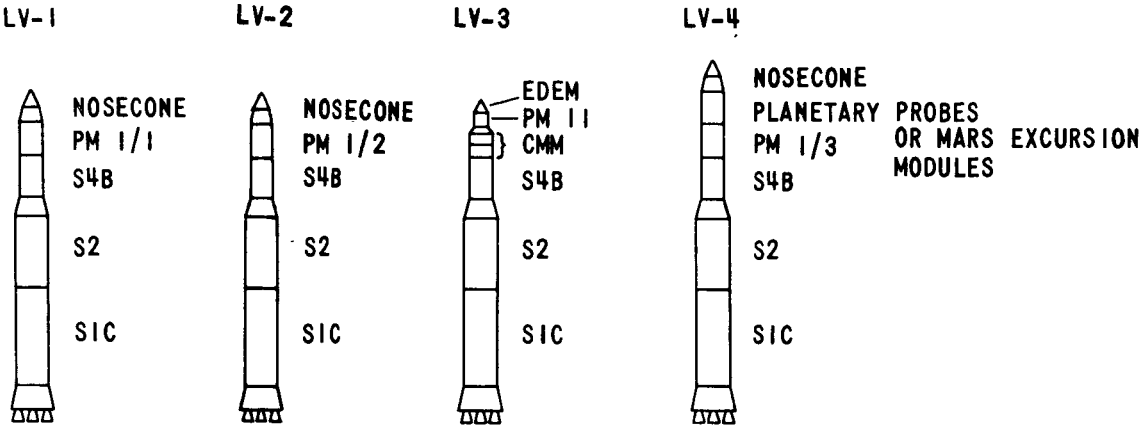
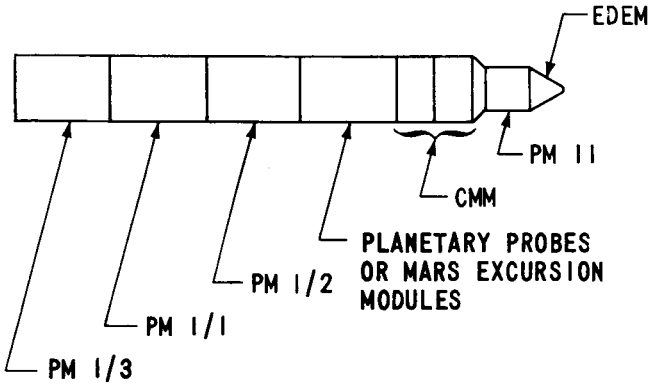


FIGURE 6 - EARTH ORBIT

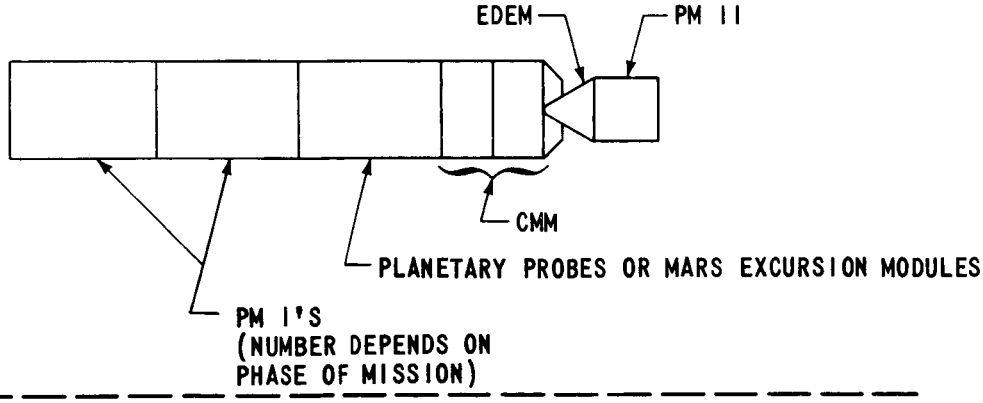
EARTH LAUNCH CONFIGURATION



HIGH ENERGY EARTH RENDEZVOUS AND DOCKING ORBIT



INTERPLANETARY COAST



EARTH RETURN

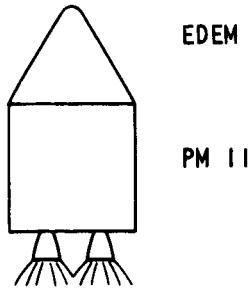


FIGURE 7 - MARS OR VENUS LANDING OR ORBIT MISSIONS

BELLCOMM, INC.

Subject: The Common Space Fleet - A Brief Description - Case 730

From: C. L. Davis
J. M. Tschirgi

Distribution List

NASA Headquarters

Copy to
Messrs. W. W. Boyes/MTY
J. R. Burke/MTV
J. H. Disher/MLD
F. P. Dixon/MTY
R. Gillespie/MTE
M. Gruber/MTY
T. Hagler/MTY
E. W. Hall/MTE
T. A. Keegan/MA-2
R. L. Lohman/MTY
D. R. Lord/MTD
R. F. Lovelett/MTY
B. G. Noblitt/MTY
L. Reiffel/MA-6
A. D. Schnyer/MTV
R. A. Summers/MTY
R. G. Voss/MTV
J. W. Wild/MTE

MSC

Messrs. C. Covington/ET23
R. D. Hodge/ET7
G. C. Miller/ET23
E. H. Olling/ET4
W. E. Stoney/ET
K. H. Strass/ET

MSFC

Messrs. H. S. Becker/R-AS-DIR
F. L. Williams/R-AS-DIR

KSC

Mr. J. P. Claybourne/EDV4

Ames Research Center

Mr. L. Roberts/M (2)

Bellcomm

Messrs. F. G. Allen
G. M. Anderson
A. P. Boysen
B. F. Brown
R. K. Chen
J. P. Downs
D. R. Hagner
P. L. Havenstein
W. G. Heffron
J. J. Hibbert
N. W. Hinners
B. T. Howard
D. B. James
J. Kranton
H. S. London
K. E. Martersteck
R. K. McFarland
J. Z. Menard
G. T. Orrok
I. M. Ross
R. N. Schmidt
R. L. Selden
R. V. Sperry
R. L. Wagner
J. E. Waldo
All Members, Div. 101
Division 103
Department 1023
Library
Central File